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ABSTRACT

Project FOCAL Point is a multi-strand project designed to increase female participation in the computing sciences. The project targets two crucial groups: high school computing teachers and female high school students. Features include a two-week teacher workshop, a one-week Computer Camp for Young Women, mini-grant projects and a follow-up conference for teacher participants, and listservs for both teacher and student participants. This paper focuses on the teacher participant responses and reactions to the two-week teacher workshop during the project's inaugural (pilot) event. Workshop objectives included: acquaint teachers with gender issues as related to computing; help teachers become aware of unconscious biases they may possess about the culture of computing; introduce teachers to instructional practices known to appeal to women and girls; provide teachers with career information; and provide teachers with technology-related content knowledge and skills. The evaluation study examined changes in computer attitudes and skills reported by teachers as a result of their participation in the workshop. Although not overwhelming, results indicated that the workshop was successful in meeting its objectives. (C0jtains 5 figures, 1 table, and 13 references.) (Author/AEF)

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Creating Gender Equitable Computing Classrooms: A Model Project

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Abstract: Project *FOCAL* Point is a multi-strand project designed to increase female participation in the computing sciences. The project targets two crucial groups: high school computing teachers and female high school students. Features include a two-week teacher workshop, a one-week Computer Camp for Young Women, mini-grant projects and a follow-up conference for teacher participants, and listservs for both teacher and student participants. This paper focuses on the teacher participant responses and reactions to the two-week teacher workshop during the project's inaugural (pilot) event.

Introduction

Few people doubt that technological skills will become increasingly important as our country enters the 21st century. Specifically, the demand for qualified computing professionals already exceeds the supply and is expected to double in the next decade. In view of the high percentage of Caucasian males currently employed in the field and continued national concern with affirmative action, businesses continue to seek out qualified women and people of color. However, despite acknowledged career opportunities and known financial advantages, these groups continue to be under-represented in the professional work force and in technology-related majors (Frenkel, 1990; Scragg & Smith, 1998). Concerned educators must question the reasons for the continued imbalance and search out avenues for addressing the equity problem.

Background

More than a decade ago, Lockheed and Mandinach (1986) expressed concerns about the high school computing curriculum. Reporting on declining student interest, the authors claimed that some of the decline was due to the poor quality and restricted curriculum of many high school courses. They reported that teachers were often minimally trained and that courses were "inadequate in scope, depth, language choice" (p. 23). Students who subsequently enrolled in college courses had first to unlearn unsuitable techniques and misconceptions. The authors' findings are consistent with those of others who researched pre-college computing students' understanding. After weeks of instruction, respected researchers have reported that many students lacked even rudimentary understanding of computing or programming concepts (Lockheed & Mandinach, 1986; Putnam, Sleeman, Baxter, & Kuspa, 1986).

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One factor contributing to the poor quality of pre-college computer science education is certainly the quality of the pre-college computer teacher's training. Lack of adequate training is a widespread problem. If we believe the literature, the impact on girls—who internalize failure; who do only what is assigned in class (Linn & Hyde, 1989); who feel alienated by an unfriendly computer culture; who respond positively to collaborative, constructive learning environments, etc.—is proportionally more negative than it is to boys.

Teachers bring to the classroom a lifetime of experiences that strongly influence the way they think about teaching and learning (Ball, 1988; Lortie, 1975). Many teachers of technologically oriented subjects have been educated in didactic and competitive classrooms. For most of their lives they have been passive learners, and many are quite comfortable in that mold. These teachers look at their best students, and the students, too, are passive learners. If teachers are to change their way of thinking and teaching, they need more than a general awareness that collaborative and constructive learning can be helpful. They need compelling evidence that the techniques will work for them and for their students, and they need it in the form of documented successes. That kind of success requires training, practice, and opportunities for reflection and sharing—precisely the experiences Project *FOCAL* Point provides.

Many rural and other schools, with limited financial resources, have no licensed computing teachers on their staff and cannot afford to hire one. These schools have two choices: either ignore computing altogether or allow under-prepared teachers to teach the subject. Neither choice is ideal. Project *FOCAL* Point offers a desirable alternative. It provides teacher participants with initial computing instruction, perhaps providing the foundation and incentive for continued study.

Project *FOCAL* Point: Implementation

The overarching goal of Project ***FOCAL*** Point is to increase female participation in the computing sciences. Specific objectives as related to the teacher participants are to:

1. Acquaint teachers with gender issues as related to computing (e.g., statistics regarding females in the field, demand for computing professionals, obstacles to success, etc.).
2. Help teachers become aware of unconscious biases they may possess about the culture of computing.
3. Introduce teachers to instructional practices known to appeal to women and girls.
4. Provide teachers with career information.
5. Provide teachers with technology-related content knowledge and skills.

The detailed objectives are largely addressed through a two-week summer workshop. The teacher workshop is a blend of training in gender issues, computer and information systems concepts, and computer and network applications—with some portion of each day devoted to each dimension. Workshop instructors incorporate a variety of active and constructive instructional strategies and delivery methods, modeling the teaching behaviors we hope to inspire.

Gender bias awareness activities range from drawing a computer scientist to examining print material and other media (textbooks, movies, television shows, software, language, greeting cards, toy store aisles) for gender bias to developing sensitivity to gender-biased language. These active learning experiences are designed to arouse awareness of gender issues as well as inform practice directly. Guest lectures, videos, and workshops round out the exposure to gender issues. A concrete models workshop (where groups work together to write directions for constructing a Tinkertoy machine) conducted by the authors, for example, has repeatedly revealed consistent (and disturbing) patterns of male-female interactions and role choices when mixed gender groups work to solve a technical problem (Madison, Gifford, & Kepner, 1997).

As enhancing teacher participants' skill and knowledge of computer and network applications is a major project objective, teachers early learn to navigate the university network. Next, they practice with e-mail software and public folders. Those skills accomplished, they join the community's discussion list and practice posting messages there. The basics accomplished, the teacher participants learn to navigate the Internet. Particular emphasis is placed on locating gender-related sites, evaluating sites and information relative to their appeal to

girls or women, and developing female-friendly Internet lessons for use with high school girls. Lastly, participants acquire the basic skills of web page production.

At first glance, instruction in these topics may seem unnecessary. It is easy to assume that everyone uses e-mail and "surfs the net." Experience with college students has shown this not to be the case. Each semester the authors come across computing students—including advanced computing students—who have not yet ventured into cyberspace. Moreover, the college students regularly volunteer that they would not have done so had it not been a course requirement. The literature offers that women are more likely than men to do only what is required of them in class (Linn & Hyde, 1989), to feel less efficacious with computers (Bernstein, 1991), and are more likely to feel alienated by a culture they view as impersonal, unfriendly, and withdrawn (Spertus, 1991; Turkle & Papert, 1990). Efforts must be made to expand the teacher participants' computer comfort zone and to help them identify more positively with the computer culture, so that they may more effectively teach their students. During the second week of the workshop, teacher participants pilot test their female-friendly technology lessons with high school girls attending a Summer Computer Camp for Young Women. The remainder of the paper elaborates on the inaugural session of the teacher workshop.

Evaluation Study

The evaluation study attempted to answer the questions:

- What changes in computer attitudes did teachers report as a result of their participation in Project *FOCAL* Point's two-week teacher workshop?
- What changes in computer skills did teachers report as a result of their participation in Project *FOCAL* Point's two-week teacher workshop?

The participants were seven computing or technology teachers (four men and three women). Six taught high school and one taught computer applications at the local technical college. All teachers applied to participate in the project. Since response to the call for participation was nominal, all applicants were accepted. As reported on their applications, all had taught a computing or technology-related course and expected to do so again in the foreseeable future. All lived and taught within two hundred miles of the university. Non-local teachers stayed in a residence hall for the duration of the workshop; all four chose to return home over the weekend. There were no fees associated with the project; moreover, teachers received three tuition-free graduate credits. Participants signed informed consent documents before any data were collected. The small sample size precludes inferential statistical analysis; hence only descriptive statistical analyses are reported.

The Computer Attitude Scale (CAS) was used to measure computer attitudes. The 40-item CAS has been shown to be valid and reliable (Loyd & Gressard, 1984; Loyd & Loyd, 1985). The CAS is composed of four 10-question sub-scales designed to measure computer anxiety, confidence, liking, and perception of usefulness. Items on the CAS with negative wording were re-recorded so that for all items, a higher item score indicates a more favorable attitude.

The teachers completed the CAS on the first day of their project participation to use as a pre-test measure and again on the last day of the summer program. (The second questionnaire serves as an interim post-test measure. It will be completed again after one year and at the project's conclusion.) The results are shown in Figure 1.

We did not expect to see dramatic changes after two weeks; however we did expect that scores would not decrease. That expectation proved only partially true. The mean for computer anxiety increased slightly (0.57) and the mean for computer confidence remained constant. In contrast, the mean for computer liking and usefulness decreased slightly. However, none of the changes are great enough to have any practical significance. With such a small data set, every answer has a large impact on the outcome. Moreover, several of the teachers observed that the negatively worded questions were hard to read. For example two teachers strongly disagreed with the statement "Computers will not be important to me in my life's work." on the pre-test and strongly agreed with the statement on the post-test. Although it is possible that the two-week workshop effected such a dramatic negative change, it seems unlikely. A more plausible explanation is that the participants misread the question. Given the small sample size, the responses have a large impact. Finally, there is likely a ceiling effect due to the high mean scores on the pre-test. The mean for each sub-scale could

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range from a low of 10 to a high of 40. The high pre-test means (37-38) make it difficult to detect changes. The pattern might well change with a different cohort.

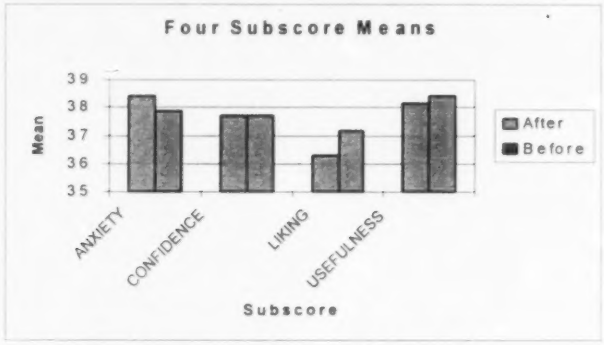

Figure 1. Computer Attitude Scale Results

The teachers were asked to complete a self-assessment of their computer experience on the first and on the last day of the two-week workshop. Figures 2 to 5 show the before/after difference in reported computing experience levels. A comparison of the before and after means show that perception of electronic mail and web

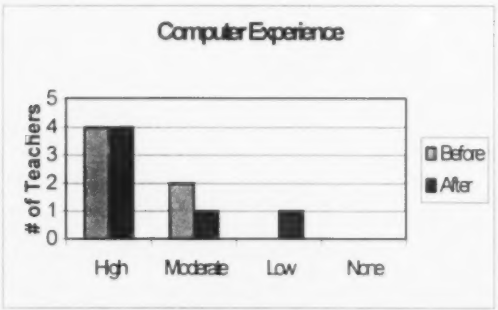

Figure 2. Computer Experience

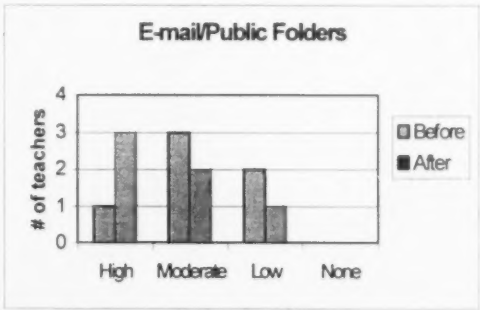

Figure 3. E-mail/Public Folders

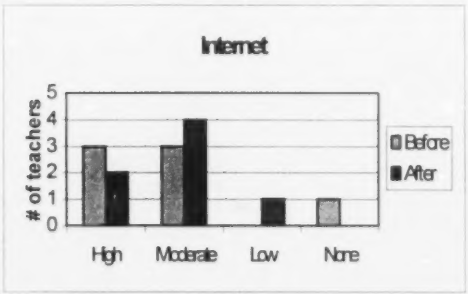

Figure 4. Internet

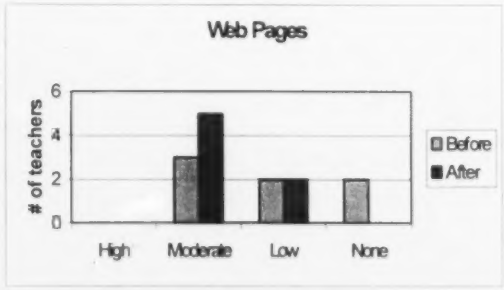

Figure 5. Web Pages

page development experience increased dramatically. The latter statistic is not surprising since five out of seven teachers (71%) had not constructed a web page prior to their participation in the summer workshop. Ability with Internet searching increased slightly, and assessment of general computer experience dropped slightly. The latter statistic may be skewed negatively, as one of the technology education teachers had done little more with the computer than use AutoCad prior to his participation in the workhop. He admitted to being challenged by the workshop; he was, in fact, not comfortable enough with the technology to attempt to teach

web page development during the second week of the workshop when the high school girls were there. Too, some teachers may have overestimated their experience level before they observed what others were doing. Unfortunately, the experience questions were (unnecessarily) tied to other project evaluations and therefore anonymous. Hence, it is not possible to draw a firm conclusion regarding the reason for the decline.

Not surprisingly (given the audience), 83% (five out of the six teachers) of the respondents agreed or agreed strongly to use e-mail or public folders in their teaching. More interesting would be the reasons for the lone respondent who responded in the negative. The teachers astutely observed that "some female students might not want to ask the questions in person, but they would ask questions through the e-mail." The authors add that this observation is probably true for more reticent males, too. From these responses, it is possible to conclude that e-mail will play an important role in the future teaching of the respondents. Can we conclude that the participants might reach more students, especially those that might "fall through the cracks"? Possibly. Once again, given the audience, it is not possible to conclude definitively that the positive response is a result of the workshop. Five out seven teachers, (71%) responded that they wanted to use Internet searching in their classroom. At least one responded that he or she was grateful for this opportunity to learn more about this new computer technology. Once again, given the audience, it is not possible to conclude definitively that the strong positive response is a result of the workshop.

As is customary for conferences and workshops, participants were daily asked to rate the individual seminar sessions. The scale ranged from Very Useful = 1 to Not at All Useful = 5. The inverse rating scale was selected intentionally to avoid the bias that could be created with the notion that "more is better." The teachers' responses to the individual sessions are shown in Table 1. The uniformly positive ratings (ranging from 1.0 to 2.0) indicate that the teachers generally found the workshop useful.

Session Name	Session Type	Rating (Mean)	# of 1's
The UWSP Campus Computing Environment	Lesson	1.67	4
Using Concrete Model to Teach Programming	Guest Presentation	1.16	5
E-mail/Public Folders using Microsoft Exchange	Lesson	2.00	3
The Internet	Lesson	1.28	5
Where CAN'T You Go On the Internet?	Guest Presentation	1.42	5
The Internet, Developing Web Pages	Lesson	1.28	6
Gender Issues	Lesson	1.42	4
Developing Web Pages, Computing Concepts	Lesson	1.28	5
Teaching Music on the Web: Technology and the Humanities	Guest Presentation	1.42	6
Teaching and Learning on the Internet	Lesson	2.00	3
Developing Web Pages, Computing Concepts	Lesson	1.42	4
Gender Issues	Lesson	1.42	4
The Top 12 Reasons the Internet is Very Scary	Guest Presentation	1.00	7
Gender Issues	Lesson	1.57	4
Mini-Grant project Brainstorming	Workshop	1.57	4
Lesson plan development	Workshop	1.71	3
Evaluation	Guest Presentation	1.42	4
Mean Rating		1.47	

Table 1. Session Evaluations

Equally encouraging are the responses to the question: "What are the most important things you learned in your role as a teacher?" Responses to the open-ended question included:

- [The workshop] called attention to my behaviors that put down female students.
- I use gender[biased] language with students and had not been aware of it--'you guys'.
- I am going to try call all my students by the first name and to encourage girls work together in computing and technology related fields.

- I need to use more concrete models in my instruction.
- I need to utilize more cooperative learning in my classes.
- Concrete models for abstract ideas---most important for females.
- Concrete ideas for making my class more friendly.

Although not overwhelming, there does seem evidence that the workshop was successful in meeting its objectives. The session ratings provide evidence that every teacher found something of worth. The open-ended comments suggest that there may be more female-friendly classrooms as a result of the workshop. Moreover, the participants perceived themselves as being more skillful and experienced at the close of the workshop than they did at its inception. Researchers studying the barriers to female retention in computer science at the State University of New York at Geneseo concluded that females were turned away before they ever reached the university (Scragg & Smith, 1998). Their recommendations: summer workshops for high school teachers and summer camps for girls. Project *FOCAL* Point is an exemplar of those recommendations, a model program that can be easily replicated by concerned computing departments nationwide.

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